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# Effect of sliver nano particles on wool fibre

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**ABSTRACT**

Sliver nano colloids have been synthesized by chemical reduction of sliver salt solution, characterized by SEM usage of nano particles. Sliver nano colloids are treated with wool fibres and dyed wool fibres (direct and acid dyes). The physical properties colour strength, fastness properties have been studied for dyed wool fibres and ordinary wool fibres. It is observed that the fibres with nano treated fibres have better strength than untreated wool fibres. It is also observed that there is considerable improvement in colour strength and colour fastness of silver nano colloids treated wool fibres (dyed).



## Introduction

During the past two decades, the small-Particle research has became quite popular in various fields of chemistry and physics. The small-paricle now we call nano structured materials are having interesting properties. Metallic nanoparticles represent a class of materials that are increasingly receiving attentation as important starting points for the generation of micro and nanostructures. These particles are under active research because they posses interesting physical properties differing considerably from that of the bulk phase. It has small sizes and high surface/volume ratio. Sliver nanoparticles have received considerable attenuation due to their attractive physical and chemical properties.

Metallic sliver colloids were first prepared more than a century ago. Ag nanoparticles can be synthesized using various methods, such as chemical, electrochemical, γ-radiation, photochemical, laser ablation, etc. The most popular preparation of Ag colloids is chemical reduction of sliver salts by sodium borohydride of sodium citrate. This preparation is simple, but the great care must be exercised to make stable and reproducible colloide. The purity of water and reagents and cleanliness of the glassware are critical parameters. Solution temperature, concentrations of the metal slat and reducing agent, and reaction time influence particle size. Controlling size and shape of metal nanoparticles remains a challenge. The size –induced properties of nanoparticles enable the development of new applications or the addition of flexibility to existing systems, in many areas, such as catalysis, optics, microelectronics and textiles. Antimicrobial effect of sliver nanoparticles on textiles has already been shown by various researchers [1-3]

Wool fiber, know for its lightness, softness, warmness, and smoothness, is known as a natural clothing material. Because wool is mainly composed of keratin, the outermost part of the fiber is the cuticle cell, of which the surface is a fatty layer of 18-methyl eicosanoic acid covalently bound to the protein layer of the wool cuticle via a thioester linkage. Because of the presence of this fatty layer, the surface of wool is hydrophobic. Therefore, the water absorption and sweat venting properties of wool fiber are not very good, which affects the wearing comfort of wool textiles [4-9]

Wool was treated with inorganic and polymer-based nanoparticles. The diffusion of nanoparticles into wool appears to be dependent on electrostatic interactions. In particular, it is optimized at low pH in which there are very few anionic groups on the wool fiber; The nanoparticles also need to have sufficient charge to maintain their stability as dispersion. The findings support the view that the cell membrane complex and other low sulphur regions are the main route of entry for both molecular and macromolecular treatment chemicals. The use of this technique to treat wool may lead to new coloration effects and other functions such as antimicrobial action. [4-14]

### Preparation of Nano Ag Colloid

The 100 mL solution of 1×10–3 M AgSO4, kept in the specially designed reaction chamber, was slowly reduced by drop-wise addition of very dilute chilled solution of sodium borohydride in a nitrogen atmosphere. During the process of reaction the solution mixture was stirred vigorously. When the colour of the solution turned to light yellow, 5 mL of 1 % trisodium citrate was added drop by drop with vigorous stirring. Distilled water was used for preparing the solutions of all the chemicals.

Silver nanoparticles were applied to the wool samples by dipping them in the dispersion for 10 min and then padded on an automatic padding mangle machine using 2-dip-2-nip padding sequence at 70% expression. The padded substrates were air dried and finally cured at 120°C for 20 min in a preheated curing oven.

These nanoparticles have been applied to the wool fibres by using the padding technique and manifested the improved microbial resistance as measured through the soil burial test. The dyeing behaviour of the sliver nano particle treated fibres with direct dyes and acid dyes have been also studied. The higher K/S values are obtained when the Ag nano is anchored in the fibre matrix.i.e. When the fibre is pre-treated and dyed with direct dyes and acid dyes. Improved colour strength with good wash and light fastness is also obtained after the treatment of fibres with nano colloids.

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## Results and Discussions

### Effect of silver nano on physical property

It is observed from Table 1 that the tenacity of sliver nano particles treated wool fibres have better strength than the untreated wool fibre and the introduction of nano silver particles into the structure of the fibre causes an improvement in the load bearing capacity of the fibre.

The nano silver particles because of their small size can enter in between the molecules and perhaps act as filler or cross linking agent which also contribute to the load sharing phenomenon during load application to the material. Unlike chemical crosslinking which causes an improvement in crease recovery angle at the cost of imparting some rigidity in the material to an extent depending on the extent of cross linking, the incorporation of nano silver particles remains quite gentle in this regard.

Wool fibres are subjected to severe mechanical actions like padding and relaxation in chemical processing reason for crimp loss in wool fibers. The crimp % of wool fibers noted in different stages. The loss of crimp and crimp recovery of single wool fibres are examined by measuring the crimp shrinkage of single from the Table 2 the crimp% of Ag treated fibers are lower than scoured wool.

It is also observed from Table 3 that the considerable reduction in moisture regain for nano sliver particle treated wool fibres. Wool is a very hygroscopic fibre picking up and losing moisture as the atmospheric conditions change. At 65% relative humidity, wool will hold 14-15% of its own weight in moisture. It will absorb more than 30% moisture before it begins to feel wet. This large variation in moisture. Similarly large variations in the weight of a consignment. Because of silver nanoparticles covered outer surface causes the moisture regain property.

### Effect of Ag Nano Treatment on Dyeing

### Color strength testing of treated and untreated fibers

The Ag nanoparticle treated wool dyed fibers with direct dyes and compared with the untreated samples. It is observed from Table 4.4 that the K/S values of the nano silver pretreated samples are not has much difference than those of the corresponding untreated wool samples direct dyes with silver nano treated samples has the better k\s value than it dyed barely with wool fibers the very suitable acid dyes has higher k/s values.

The higher K/S values (Table 4) of nano-treated samples indicate that the presence of nano metal particles increases the dye affinity towards the material. The silver nanoparticles in the fabric thus act as mordant. The negatively charged dye anions get attracted towards the fibre probably due to the polarity developed in the metal particles by induction which results in better bonding between the dye and the fibre.

The better coupling of the dye and the fibre is also reflected in the improvement in the colour fastness properties. Thus, silver nano pre- treatment not only improves the colour strength but also improves the colour fastness which is a major drawback of most direct dyes.

### Surface analysis by SEM

The surface of treated wool fabrics were observed by SEM. In Fig. 1, SEM images show on wool scales that were treated with 100 ppm of silver contents. The nano-silver particles bigger than 4.2 nm of particles in SNSE solution were observed in Fig. 1b. The agglomerated particles may attributable to the thermo-migration of the nano-sized silvers happened during curing process.

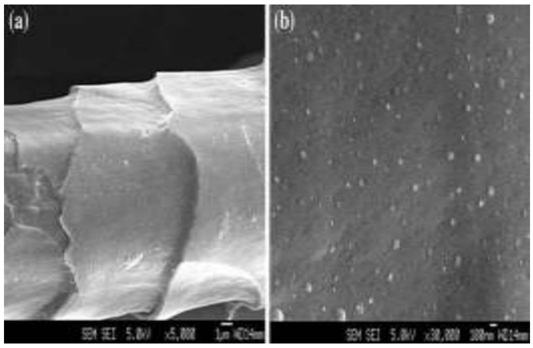

**Figure Surface images of wool fiber having 100 ppm silver particles with sulfur nano-silver colloid; (a) 5,000 magnifications (b) 30,000 magnifications**

### Anti bacterial property

Nanosized silver particles in colloidal solution had excellent antibacterial effect on all specimens against gram-positive and gram negative bacteria. Data's shows the antibacterial effect of nanosized silver colloidal solution on processed fabric. In the result, the bacterial reduction of all specimens was very excellent against E- coli. In this study, the application of silver nano particles as an antimicrobial agent was investigated by growing E-coli on agar plates. When nano particles were present on agar plates, they could completely inhibit the bacterial growth. However, inhibition depends upon concentration of silver nano particles.

It is clear that treated bacteria also show significant changes in and damages to membranes. The fabrics padded through 30ml/l silver colloidal solution also had better activity than the samples treated with 20ml/l solution at 22°C.

With the results obtained from antimicrobial test shows that, silver concentration at the10ml/l and temperature at 22°C the antimicrobial activity increases with increases in curing time.The higher bacterial inhibition also obtained at 30ml/l and 22°C with the increase in curing time. The bacterial inhibition at 20°C is very less when compared to 22°C and 24°C with increase in curing time.

### Conclusion

Sliver nano colloids have been synthesized by chemical reduction of sliver salt solution, characterized by SEM image of nano particles.

- The samples treated with silver nanoparticles shows better tensile strength, drying time than normal samples
- Nano Ag treatment enhances the colour strength of wool and dyed with direct dyes and also improve the fastness towards light and washing.
- Ag nano treatment to wool improves the resistance to microbial attack.

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**Table 1. Tenacity of treated and untreated samples**

| SAMPLE NO | UNTREATED (gram/denier) | TREATED (gram/denier) |
|---|---|---|
| 1 | 1.33 | 1.99 |
| 2 | 1.12 | 1.84 |
| 3 | 1.32 | 1.90 |
| 4 | 1.08 | 1.69 |
| 5 | 0.90 | 1.52 |

**Table 2. Crimp% of treated and untreated samples**

| SAMPLE NO | CRIMP IN RAW WOOL | CRIMP IN DYED WOOL | CRIMP LOSS(%) | CRIMP IN Ag NANO COLLOIDAL TREATED &DYED WOOL | CRIMP LOSS(%) |
|---|---|---|---|---|---|
| 1. | 33 | 29 | 12.1% | 27 | 18 |
| 2. | 30 | 26 | 13.3% | 24 | 20 |
| 3. | 31 | 28 | 12.9% | 26 | 16 |
| | | avg | 12.7% | | 18 |

**Table 3. Moisture regain% of treated and untreated samples**

| SAMPLE N0 | UNTREATED WOOL | | | TREATED WOOL | | |
|---|---|---|---|---|---|---|
| | BEFORE | AFTER | M.R (%) | BEFORE | AFTER | M.R (%) |
| 1 | 1.39 | 1.21 | 14.8 | 0.301 | 0.272 | 10.67 |
| 2 | 0.733 | 0.634 | 13.5 | 0.41 | 0.368 | 11.4 |
| 3 | 0.573 | 0.497 | 15.2 | 0.382 | 0.345 | 10.72 |